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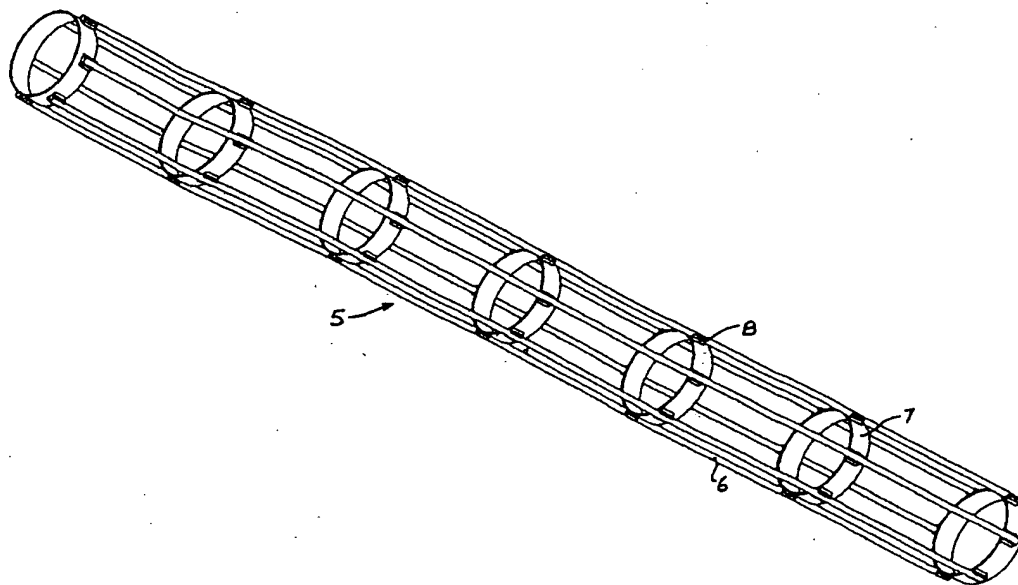
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- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **HOLLOW FIBRE RESTRAINING SYSTEM**



(57) Abstract: A restraining system for hollow fibres including a plurality of longitudinally extending elements (6) spaced from one another and supported by a number of discrete spacer elements (7), each spacer element (7) extending generally transverse of said longitudinal elements (6) such that in combination with said longitudinal elements (6) they define a cage-like structure (5).

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TITLE: HOLLOW FIBRE RESTRAINING SYSTEM

#### TECHNICAL FIELD

The present invention relates to a restraining system for hollow fibres used in membrane filtration systems.

#### 5 BACKGROUND OF THE INVENTION

A number of different types of restraining systems usually in the form of a welded plastic mesh cage have been used in the past, however, these suffer from lack of rigidity when large apertures are required in the mesh to allow for fluid flows and are difficult to repair should any portion of the mesh be broken  
10 during transport, installation or use. While such known restraining systems are cheap and simple to manufacture they suffer from a lack of robustness in many required installations.

The present invention seeks to overcome or at least ameliorate one or more of the disadvantages of the prior art or at least provide the public with a  
15 useful alternative.

#### SUMMARY OF THE INVENTION

According to one aspect, the present invention provides a restraining system for hollow fibres including a plurality of longitudinally extending elements spaced from one another and supported by a number of discrete spacer  
20 elements, each spacer element extending generally transverse of said

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longitudinal elements such that in combination with said longitudinal elements they define a cage-like structure.

For preference, the cage-like structure is tubular. Preferably, the longitudinal elements are rods and the spacer elements are in the form of rings.

5 It will be appreciated that the rings may of any geometric shape and are not limited to a circular shape. Similarly, the tubular structure and rods may be of any geometric cross sectional shape.

In one preferred form, each ring has a number of radially extending engagement formations for releasably engaging an associated rod. The  
10 formations may be in the form of part-circular opposed flanges spaced to provide a socket having an interference or snap-fit with the associated rod.

In another preferred form, each ring has a number of radially extending cut-outs spaced around its periphery, each cut-out being sized and shaped to form an interference or snap-fit with an associated rod. Preferably, the internal  
15 surface of each ring is bevelled along each internal edge. For further preference, the internal surface of each ring is providing with a cushioning element. Preferably, the cushioning element is formed of a foam material and extends past the length of each ring at both ends so as to overlap the internal edges of each ring.

20 The spacer elements may be formed from a number of sub-elements which are fixed together in use.

The cut-outs or sockets are preferably equally-spaced around the periphery of the ring.

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For preference, the rods have a reduced diameter or width at the location where they engage with an associated spacer. Preferably, the reduced diameter is provided by a circumferential groove or slot.

The components of the system are preferably formed of generally rigid  
5 plastics material, typically nylon and acrylonitrile butadiene styrene (ABS). The components can be moulded or machined to the desired configuration. The cut-outs are preferably part circular in cross section with an opening slightly smaller than the diameter to provide for snap-fitting retention of the rods.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 shows a perspective view of the restraining system according to one embodiment of the invention;

Figure 2 shows a perspective view of the spacer component of the  
15 restraining system of Figure 1;

Figure 3 shows an enlarged exploded perspective view of the restraining system of Figure 1;

Figure 4 shows a perspective view of the restraining system according to a second embodiment of the invention;

20 Figure 5 shows a perspective view of the snap ring component of the restraining system of Figure 4;

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Figure 6 shows a perspective view of the adaptor ring component of the restraining system of Figure 4;

Figure 7 shows a perspective view of the restraining system according to a third embodiment;

5        Figure 8 shows a perspective view of the snap ring component of the restraining system of Figure 7;

Figure 9 shows a perspective view of the adaptor ring component of the restraining system of Figure 7;

10       Figure 10 shows a perspective view of the restraining system according to a fourth embodiment;

Figure 11 shows a perspective view of the snap ring component of the restraining system of Figure 10;

Figure 12 shows a perspective view of the adaptor ring component of the restraining system of Figure 10; and

15       Figure 13 shows an enlarged perspective view of the end of the restraining system of Figure 4.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figures 1 to 3, the restraining system comprises a generally tubular cage-like structure 5 formed from a plurality of longitudinally extending  
20       rods 6 spaced from one another and held in position by a number of longitudinally spaced and transversely extending spacer rings 7.

- 5 -

Each spacer ring 7 in this embodiment has a number of engagement sockets 8 spaced equally around its periphery. Each socket 8 is formed by part-circular opposed flanges 9 spaced to provide an interference or snap-fit with the associated rod 6. The sockets 8 are slightly over semi-circular in shape to  
5 provide retention of the rods 6.

Referring to Figures 4 to 13 of the drawings, each ring 7 in these embodiments has a number of radially extending cut-outs 10 equally spaced around its periphery, each cut-out 10 being sized and shaped to form an interference or snap-fit with an associated rod 6. The cut-outs 10 in this  
10 embodiment are slightly over semi-circular in shape to provide retention of the rods 6.

The rods 6 in this embodiment are provided with a circumferential groove or slot 11 to provide a reduced diameter/width at the location where they engage with the ring 7. This serves to prevent longitudinal movement of the  
15 rings 7 relative to the rods 6.

Each end of the tubular restraining structure 5 is provided with terminating adaptor ring 12 which, in use, mounts the structure 5 to a potting sleeve 16 or the like. The adaptor ring 12 includes a inner ring 13 having a plurality of openings 14 to allow passage of fluid therethrough and a radial extending  
20 circumferential rib 15. Rib 15 is again provided with a corresponding number of cut-outs 16 as those provided on the spacer rings 7 for engaging with the ends 17 of rods 6.

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As shown in the various embodiments, the spacer rings 7 are preferably arranged in closely-spaced pairs. Further, the number of rods and rings can be varied according to restraint requirements. As best shown in Figure 10, the density of rod numbers can also be varied along the length of the tubular structure 5 where restraint requirements vary along the length.

The restraining system is used to restrain a bundle of hollow fibre membranes employed in filtration systems. The fibre bundle extends longitudinally within the tubular restraining system. The restraining system allows fluid flow to and from the hollow fibre membranes. Typically, the fibres extend between upper and lower headers which, together with the restraining system, can be used to form a replaceable fibre bundle module. In such arrangements, the cage has the added advantage of protecting the fibre bundle during deployment of the module.

It will be appreciated, that further embodiments and exemplifications of the invention are possible without departing from the spirit or scope of the invention described.

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## CLAIMS:

1. A restraining system for hollow fibres including a plurality of longitudinally extending elements spaced from one another and supported by a number of discrete spacer elements, each spacer element extending generally transverse  
5 of said longitudinal elements such that in combination with said longitudinal elements they define a cage-like structure.
2. A restraining system according to claim 1 wherein the cage-like structure is tubular.
3. A restraining system according to claim 1 or claim 2 wherein the  
10 longitudinal elements are rods and the spacer elements are in the form of rings.
4. A restraining system according to claim 3 wherein each ring has a number of radially extending engagement formations for releasably engaging an associated rod.
5. A restraining system according to claim 4 wherein the formations are in the  
15 form of part-circular opposed flanges spaced to provide a socket having an interference or snap-fit with the associated rod.
6. A restraining system according to claim 3 wherein each ring has a number of radially extending cut-outs spaced around its periphery, each cut-out being sized and shaped to form an interference or snap-fit with an associated rod.
- 20 7. A restraining system according to claim 6 wherein the cut-outs are part circular in cross section with an opening slightly smaller than the diameter to provide for snap-fitting retention of the associated rod.



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8. A restraining system according to any one of claims 5, 6 or 7 wherein the cut-outs or sockets are equally-spaced around the periphery of the ring.
9. A restraining system according to any one of claims 3 to 8 wherein the rods have a reduced diameter or width at the location where they engage with  
5 an associated spacer.
10. A restraining system according to claim 9 wherein the reduced diameter is provided by a circumferential groove or slot.
11. A restraining system according to anyone of the preceding claims wherein the spacer elements are formed from a number of sub-elements which are fixed  
10 together in use.
12. A restraining system according to anyone of claims 3 to 11 wherein an internal surface of each ring is bevelled along each internal edge.
13. A restraining system according to anyone of claims 3 to 12 wherein the internal surface of each ring is providing with a cushioning element.
- 15 14. A restraining system according to claim 13 wherein the cushioning element extends past the length of each ring at both ends so as to overlap the internal edges of each ring.
15. A restraining system substantially as hereinbefore described with reference to any one of the embodiments of the invention illustrated in the  
20 accompanying drawings.

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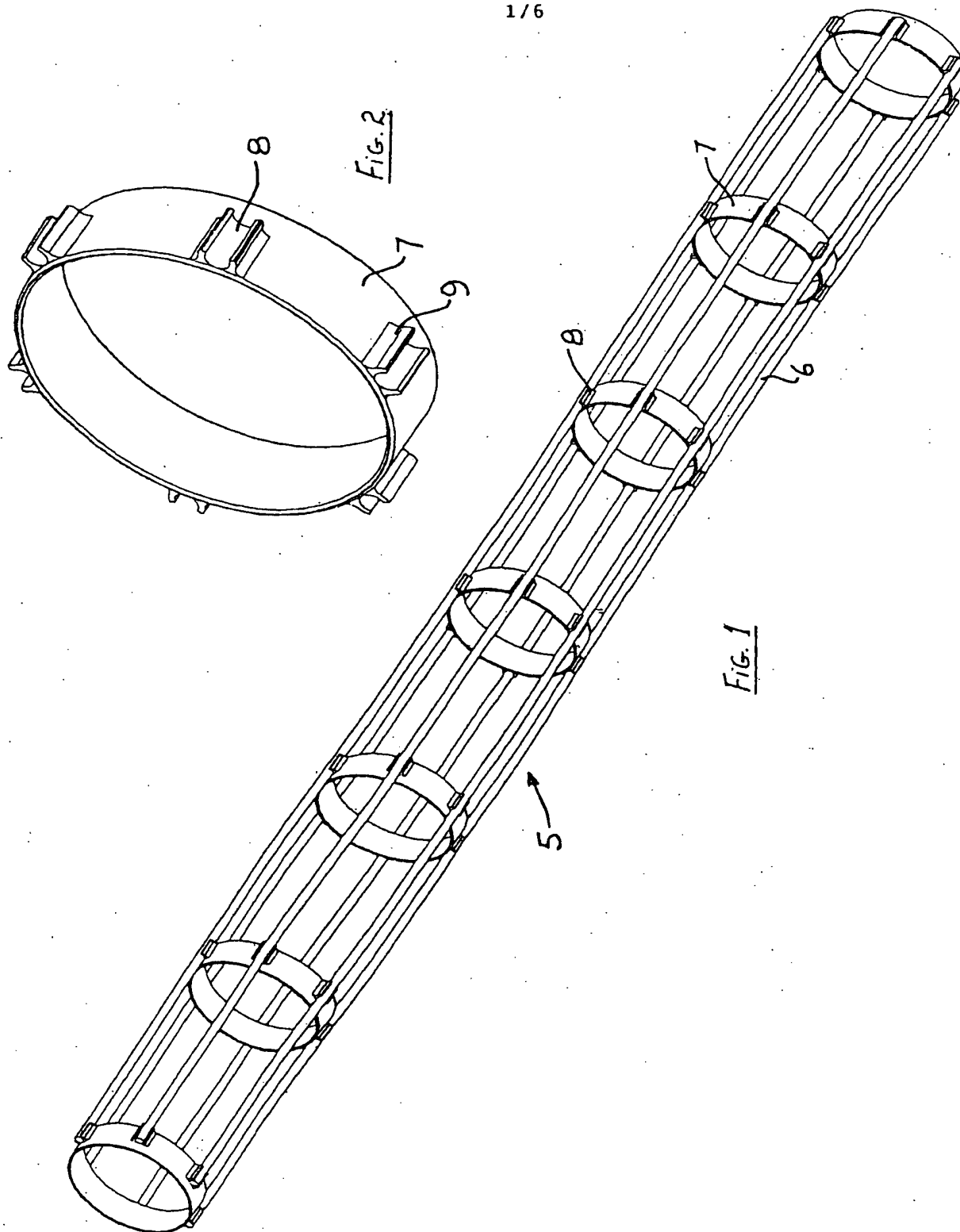
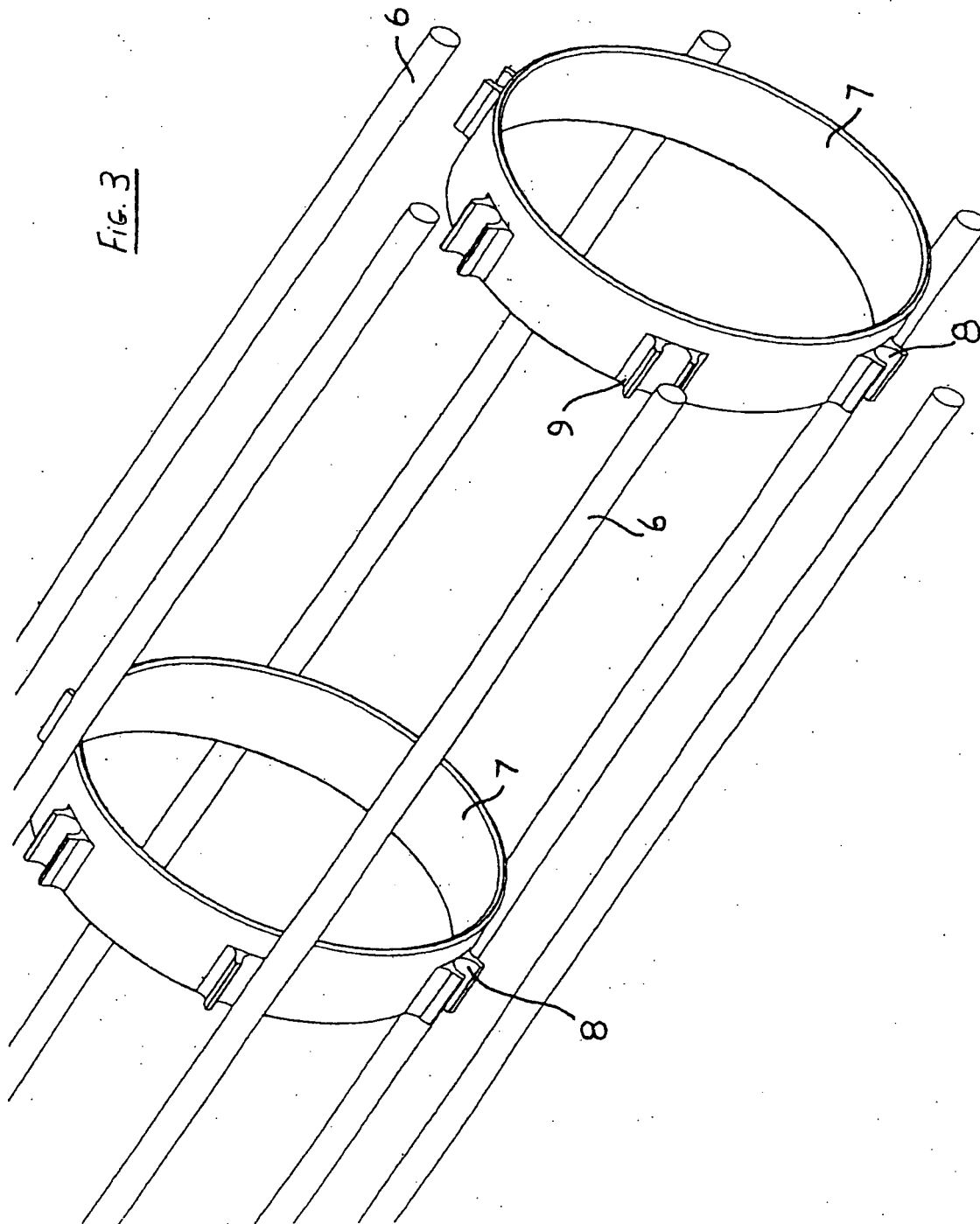
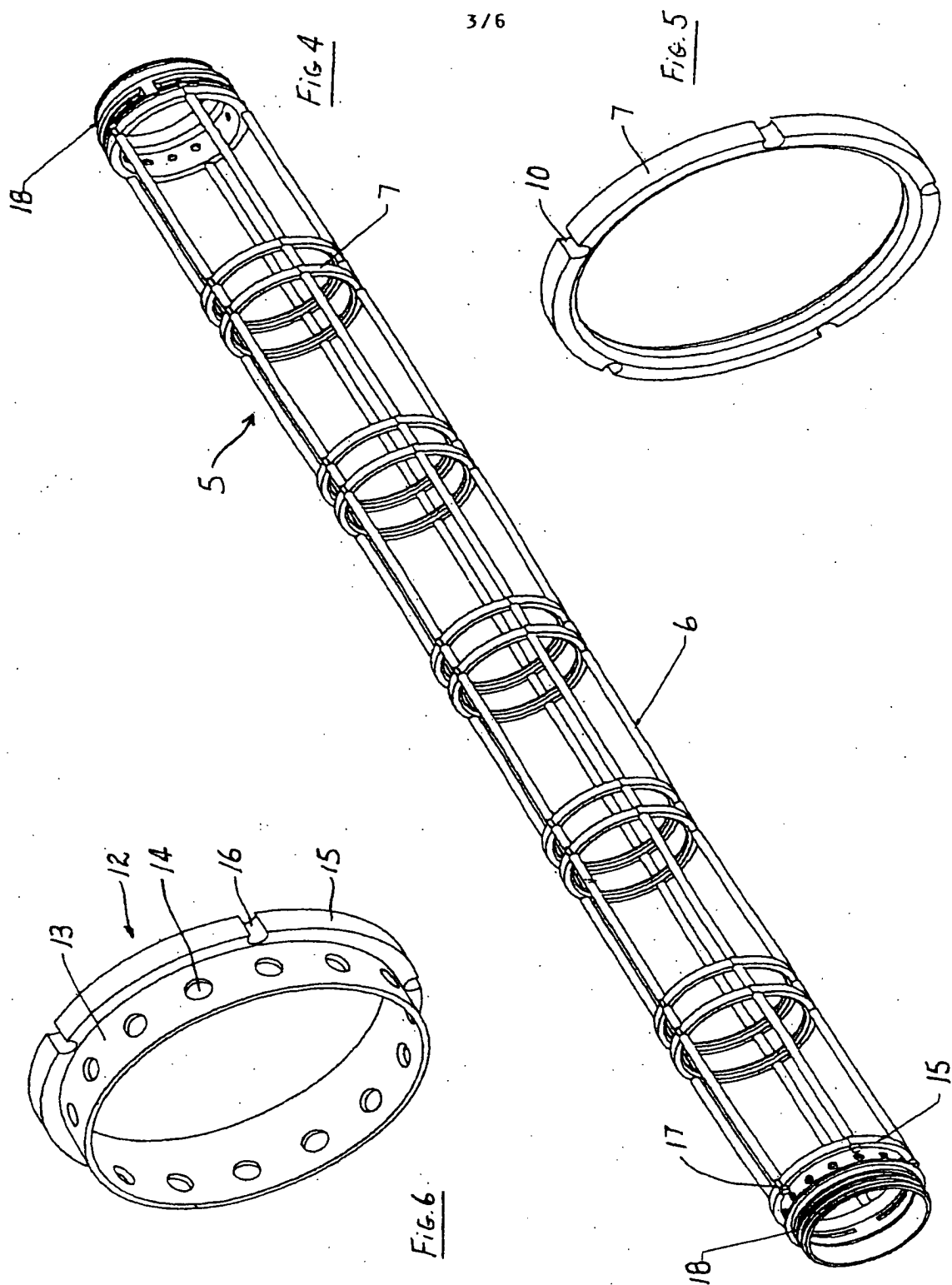
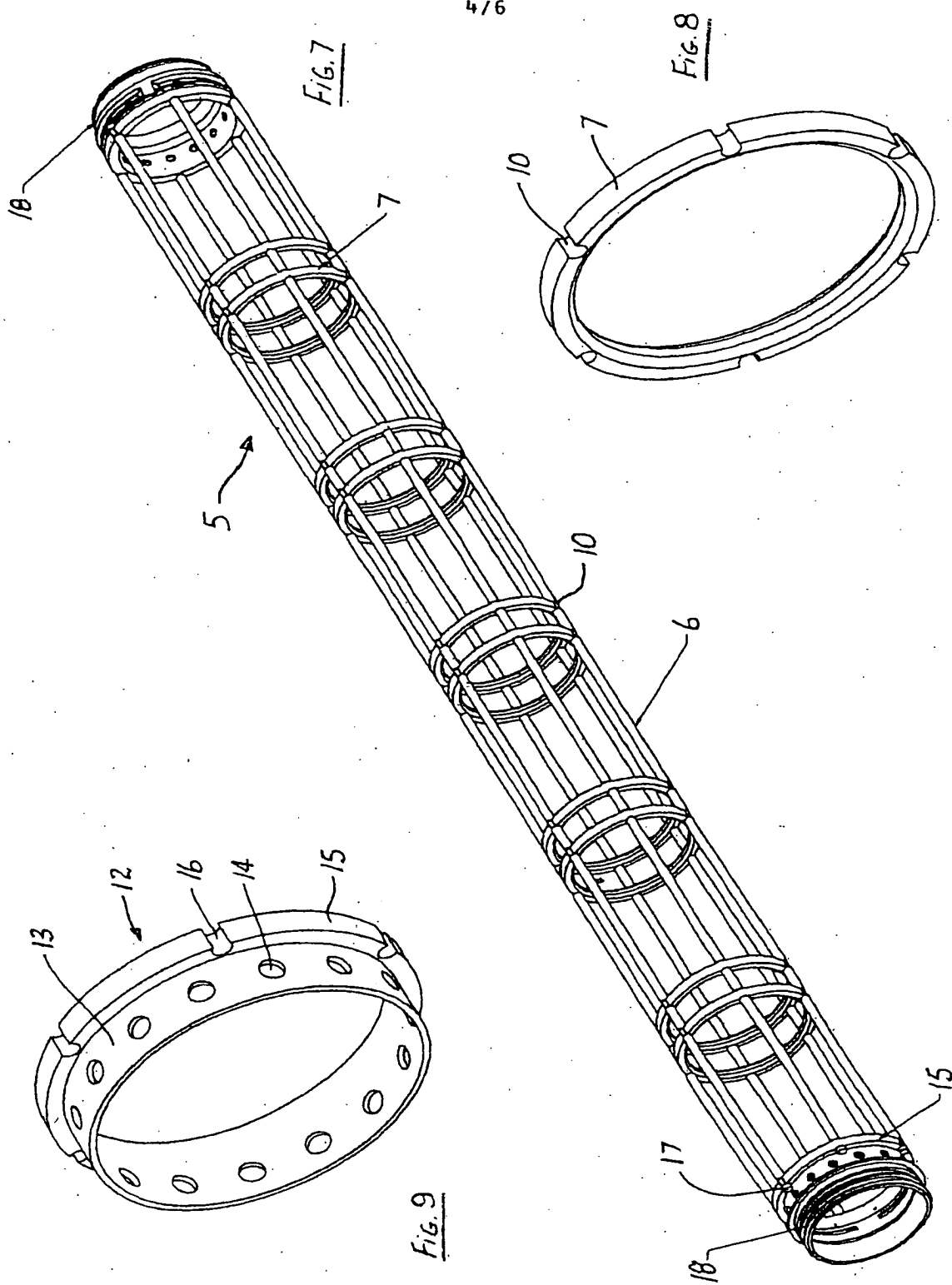


Fig. 3

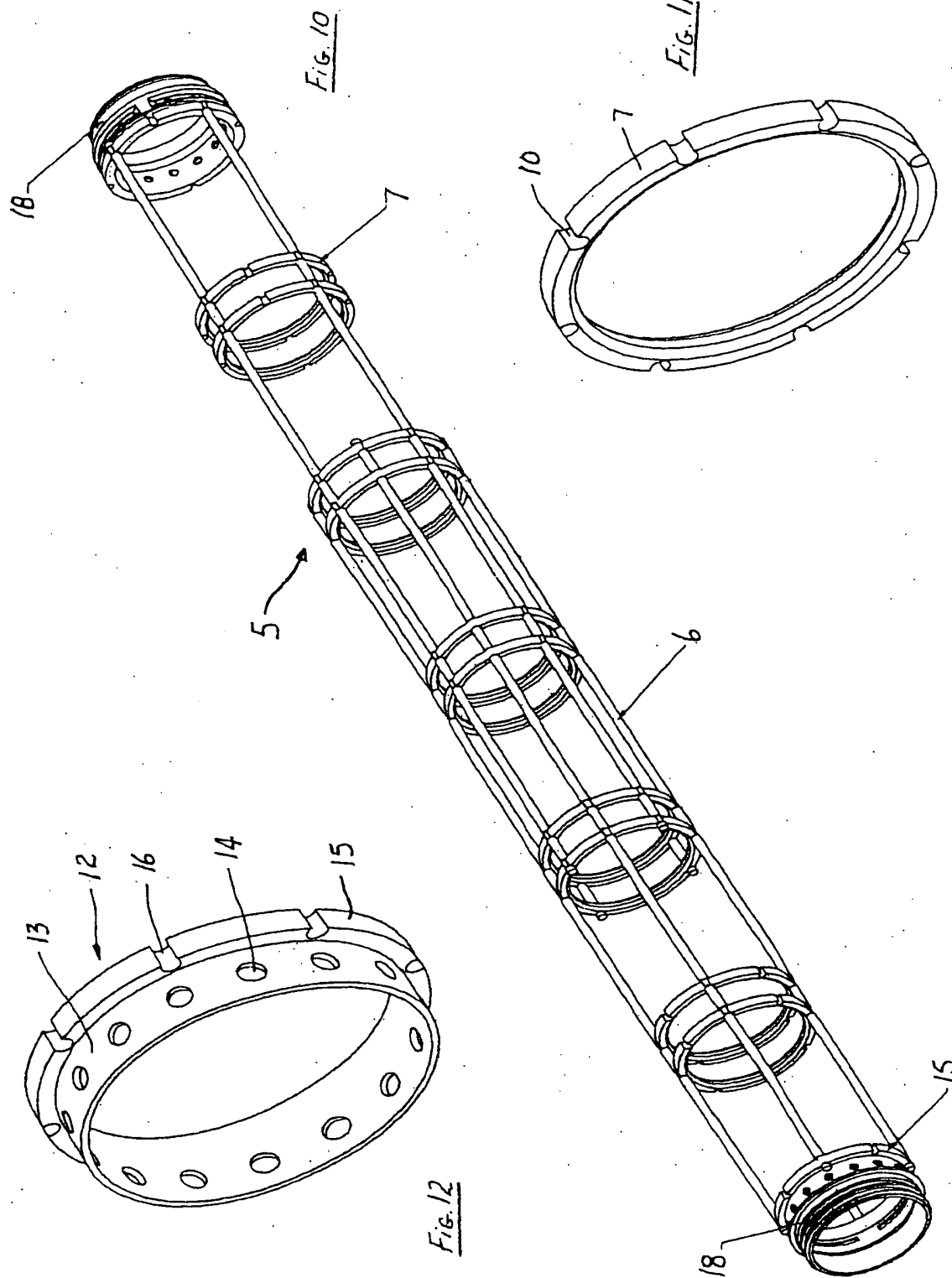


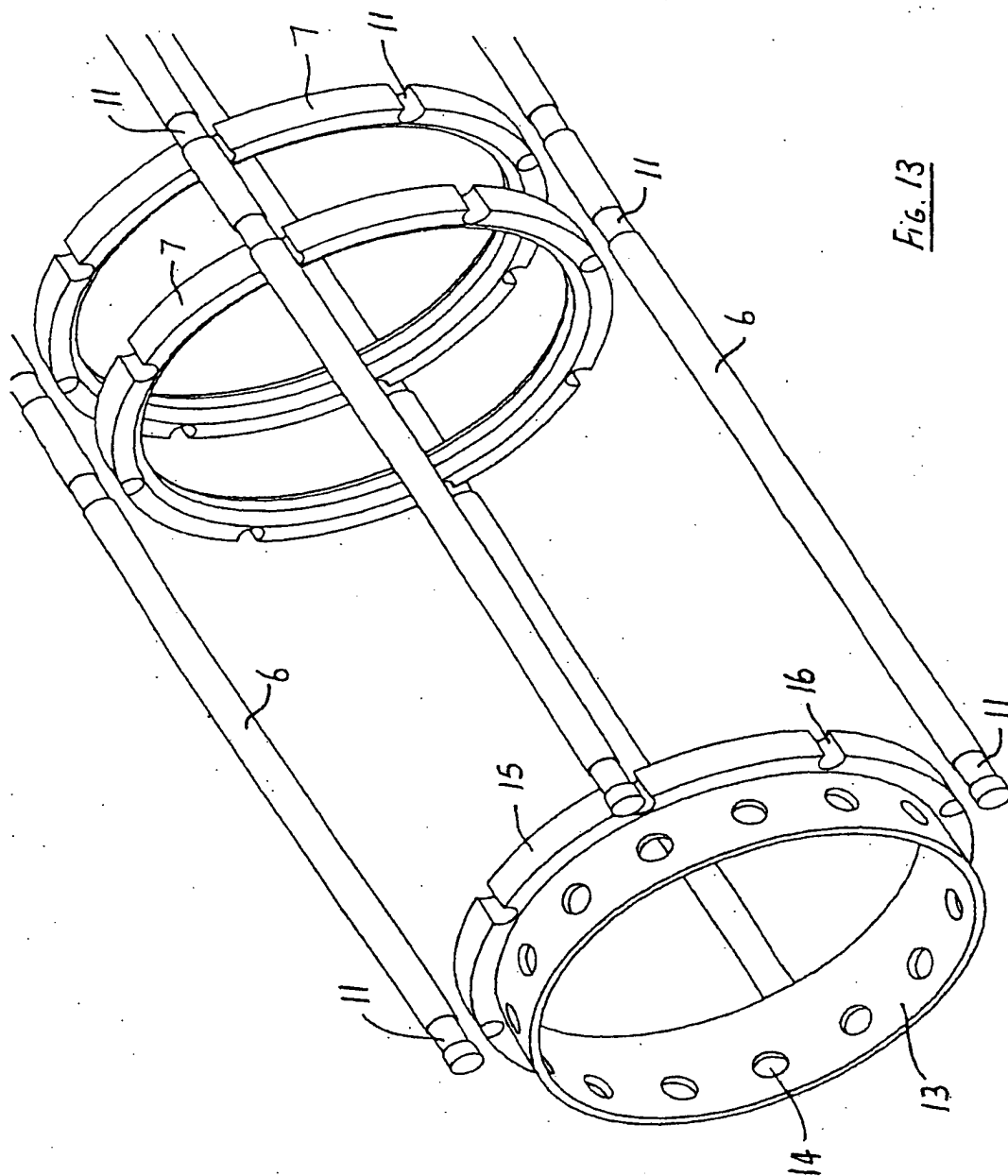
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## INTERNATIONAL SEARCH REPORT

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PCT/AU01/00387**A. CLASSIFICATION OF SUBJECT MATTER**Int. Cl. <sup>7</sup>: B01D 65/00, 63/02

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**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

B01D 65/00, 63/02, 61/10, 61/20, 61/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Derwent Abstract Accession No. 2000-091712/08, Class A88 D22 J01, JP11333265 (NITTO DENKO CORP) 12 July 1999	
A	Derwent Abstract Accession No. 2000-494064/44, Class D15 J01, JP2000185220 (ASAHI KASEI KOGYO KK) 7 April 2000	



Further documents are listed in the continuation of Box C



See patent family annex

## \* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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